GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
GEORGIA GEOLOGIC SURVEY

PREPARED IN COOPERATION WITH THE
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

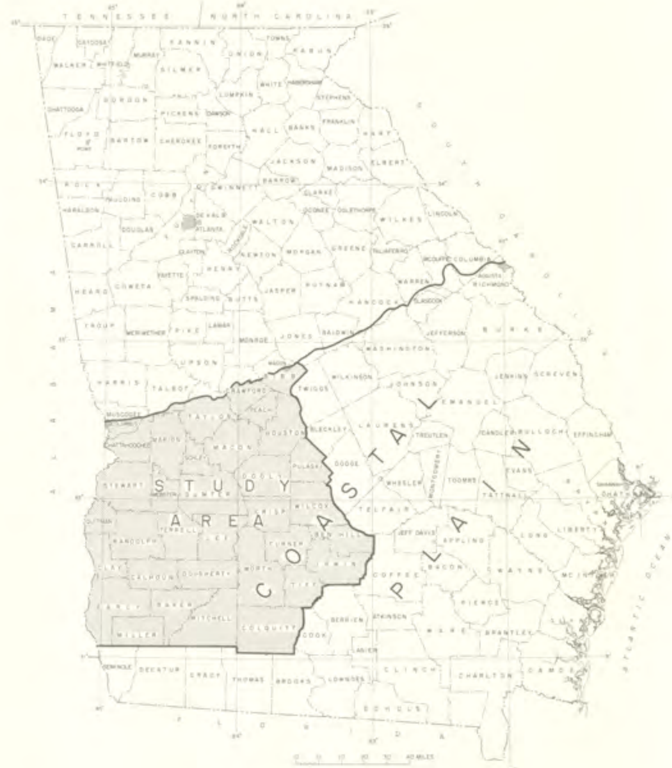

Figure 1.— Location of study area.

Table 1.—Generalized correlation of stratigraphic, lithologic, and aquifer units of Mesozoic and Cenozoic age in southwest Georgia

Erathem	System	Series	Gulf Coast stage	Group and formation Chattahoochee River area	Lithology	Aquifer (A) or confining zone (C) (Pollard and Vorhis, 1980)	Aquifer or confining zone this report	Thickness (feet)
Cenozoic	Quaternary	Holocene						
		Pleistocene						
	Tertiary	Miocene						
		Oligocene	Chickasawhayan / Vicksburgian					
		Eocene	Jacksonian	Ocala Limestone	Alternating layers of sand, clay, and limestone		Ocala aquifer	0 - 200
			Claibornian	Claiborne Group: Lisbon Formation			Lisbon confining zone	0 - 70
				Claiborne Group: Tallahatta Formation			Claiborne aquifer	0 - 270
			Sabinian	Wilcox Group: Hatchetigbee Formation			Wilcox confining zone. Sandy layers within this zone may yield sufficient quantities of water for domestic supply	0 - 260
		Paleocene		Wilcox Group: Tuscahoma Sand and Nanafalia Formation, undifferentiated				
			Midwayan	Midway Group: Clayton Formation (upper unit)	Sand, fine to medium; quartz, calcareous; interbedded thin limestone [1]			
				Midway Group: Clayton Formation (limestone unit)	Limestone, light-gray, massive, recrystallized; fossiliferous at the top [1]		Clayton aquifer. Forms single aquifer unit with the upper member of the Providence Sand updip	0 - 300
				Midway Group: Clayton Formation (lower unit)	Sand, fine to medium, arkosic; locally glauconitic and silty [1]		Clayton-Providence confining zone. Where absent, the upper member of the Providence Sand and the Clayton Formation form a single aquifer unit	0 - 130
Mesozoic	Cretaceous	Upper Cretaceous (Gulfian)	Navarroan	Providence Sand (upper unnamed sand member)	Sand; grades from a thickly bedded sand updip to a massive marine sand containing calcareous intervals downdip. [1] In Albany, Dougherty County, upper part is a dense clayey sand. Middle part is a slightly dolomitic coquina grading upward to a siltstone. Lower part is sand containing varying amounts of silt [1]	A2	Providence aquifer. Forms a single aquifer unit with the Clayton Formation updip and Cusseta Sand and Ripley Formation downdip	0 - 380
				Providence Sand (Perote member)	Silt or very fine sand, dark-gray; highly micaceous, carbonaceous. East of Schley County, merges with upper member through facies change to coarse sand [3]	C2	Providence-Ripley confining zone. Where absent, the Providence Sand and upper part of Cusseta Sand form a single aquifer unit termed the Providence-Cusseta aquifer	0 - 300
				Ripley Formation	Sand, fine, clayey, micaceous, fossiliferous; undergoes an eastward facies change to a clayey coarse sand between the Flint and Ocmulgee Rivers [4]			
			Navarroan / Tayloran	Cusseta Sand	Sand; coarse; increasing amounts of thinly bedded carbonaceous clay toward the upper contact. Size and amount of sand decreases downdip where micaceous silt and clay dominate [2]	A3	Cusseta aquifer. Upper part forms a single aquifer unit with the Providence Sand and the Ripley Formation downdip and eastward	0 - 150
			Tayloran	Bluffton Formation	Sand, fine, micaceous, calcareous; contains varying amounts of silt and clay	C3 / A4 / C4 / A5	Bluffton aquifer	0 - 700
			Austinian	Eutaw Formation	Alternating layers of sand, sandy clay, and clay	C5		
			Eaglefordian and Woodbinian	Tuscaloosa Formation		A6 / C6		

1 Hicks and others, 1981, p. 4
2 Reinhardt and others, 1980, p. 388
3 Eargle, 1955, p. 70
4 Eargle, 1955, p. 56

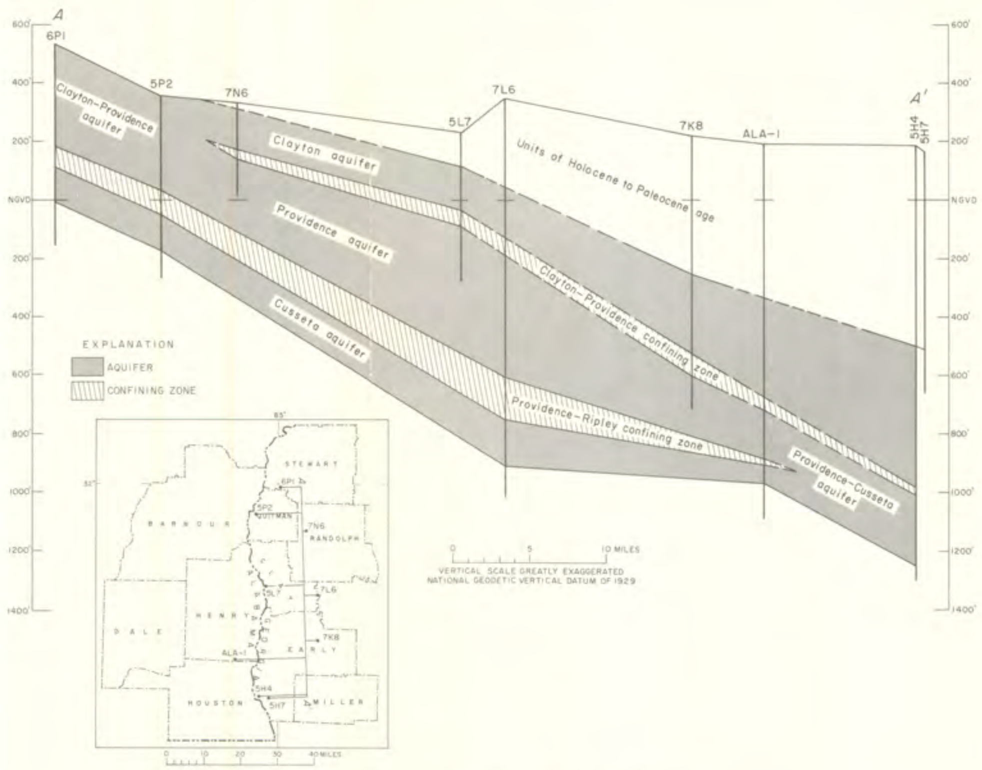

Figure 2.— Hydrogeologic section of southwest Georgia.

FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM OF UNITS (SI)

Multiply	By	To obtain
feet (ft)	0.3048	meters (m)
inches (in.)	25.4	millimeters (mm)
miles (mi)	1.609	kilometers (km)
square miles (mi^2)	2.590	square kilometers (km^2)
gallons per minute (gal/min)	0.06309	liters per second (L/s)
million gallons per day (Mgal/d)	0.04381	cubic meters per second (m^3/s)
	43.81	liters per second (L/s)
cubic feet per second per square mile [$ft^3/s/mi^2$]	0.01093	cubic meters per second per square kilometer [$m^3/s/km^2$]
Transmissivity		
feet squared per day (ft^2/d)	0.0929	meters squared per day (m^2/d)

National Geodetic Vertical Datum of 1929 (NGVD of 1929). A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada. It was formerly called Sea Level Datum of 1929 or mean sea level in this series of reports. Although the datum was derived from the average sea level over a period of many years at 26 tide stations along the Atlantic, Gulf of Mexico, and Pacific Coasts, it does not necessarily represent local mean sea level at any particular place.

WELL-NUMBERING SYSTEM

Wells in this report are numbered according to a system based on 7-1/2 minute topographic quadrangle maps of the U.S. Geological Survey. Each quadrangle in the State has been given a number and a letter designated according to its location. The numbers begin in the southwest corner of the State and increase eastward. The letters begin in the same corner, but progress alphabetically to the north. Additional information regarding wells used in this report may be obtained by referring to the well identification number in any correspondence to the U.S. Geological Survey, Suite B, 6481 Peachtree Industrial Boulevard, Doraville, GA 30360.

INTRODUCTION

Since 1950, population growth and changes in farming practices in southwest Georgia have resulted in a significant increase in agricultural, industrial, and municipal ground-water use. From 1950-80, ground-water use increased 230 percent in Americus and 240 percent in Albany. Heavy pumping in these areas caused water levels in the Providence aquifer to decline more than 100 ft during this 30-year period.

The purpose of this study was to define the areal extent of the Providence aquifer and its hydrologic, geologic, and water-quality characteristics, and determine the water use and long-term trends of water levels in the aquifer. The location of the study area is outlined in figure 1.

Historical and modern water-level, water-quality, and water-use data were evaluated to gain an understanding of the effect of man on the ground-water flow system. During October 20-24, 1980, water-level measurements were made in wells distributed throughout the study area. These measurements, together with data listed by Stephenson and Veatch (1915); Wait (1963); Owen (1963); and from data files of the U.S. Geological Survey; the Georgia Geologic Survey, Environmental Protection Division; and numerous consulting and drilling firms, were used to construct the estimated 1951 and October 1980 potentiometric surface of the Providence aquifer. During 1980, a test well was drilled through Tertiary and Upper Cretaceous sediments in Pulaski County. Structure and thickness maps of the Providence aquifer were constructed from geophysical and lithologic data from the Pulaski test well, and other wells distributed throughout the study area.

This atlas is part of a series intended to present results of the lower Tertiary-Upper Cretaceous aquifer study being conducted as part of the Georgia Accelerated Ground-Water Program.

ACKNOWLEDGMENTS

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The preparation of this report would not have been possible without the cooperation and assistance of well owners, drillers, and managers of town and industrial waterworks throughout the study area. The writers wish to thank Mr. Conway Mizelle of Insurance Services of Georgia for supplying historical records of municipal water use in the study area. Charles C. Smith and Norman F. Sohl, U.S. Geological Survey, provided paleontological correlations for test well 1 in Albany. Raymond A. Christopher, U.S. Geological Survey, provided palynological identifications and Lucy E. Edwards, U.S. Geological Survey, provided paleontological identifications for the Arrowhead test well in Pulaski County.

GEOLOGY

The study area lies within the southwestern part of the Coastal Plain physiographic province of Georgia. Sediments within the area consist primarily of alternating layers of sand, clay, shale, and limestone extending to a depth of at least 5,000 ft. Sediments are generally exposed in northeast trending outcrop belts and gently dip to the southeast, progressively thickening in that direction.

The Cretaceous formations of Georgia were divided by Pollard and Vorhis (1980) into a series of aquifers (A) and confining zones (C) (table 1). The Providence aquifer corresponds to the A2 aquifer of Pollard and Vorhis (1980) and consists primarily of the upper unnamed sand member of the Providence Sand. The Providence Sand is the youngest of the predominantly sand and clay Upper Cretaceous formations of southwest Georgia. In the Chattahoochee River valley, it consists of two units, the lower Perote Member and an upper unnamed sand member (Reinhardt and Gibson, 1980, p. 388). In updip areas along the Chattahoochee River, the Perote Member consists of silt or very fine sand and the upper unnamed member consists of fine to coarse sand (table 1).

The Providence Sand conformably overlies the Upper Cretaceous Ripley Formation and is unconformably overlain by the Clayton Formation of early Paleocene age, and younger units of Paleocene to Holocene age. The general stratigraphy and lithology of the Providence Sand and contiguous units are described in table 1.

Table 2.—Record of wells used in section A-A'

Aquifers (A): Pc, Clayton; Pc-Kp, Clayton-Providence; Kp, Providence; Kp-Kc, Providence-Cusseta; Kc, Cusseta
Confining zones (C): Pc-Kp, Clayton-Providence; Kp-Kr, Providence-Ripley

County	Well No.	Georgia Geologic Survey No.	Latitude-longitude	Owner or name	Altitude of land surface (ft)	Aquifers (A) and confining (C) zones	Altitude of top based on NGVD of 1929	Thickness (ft)	Remarks
Stewart	6P1	716	315933-0845910	H. S. Bradley, 1	535	Pc-Kp (A) Kp-Kr (C) Kc (A)	(?) 180 110	(?) 70 115	
Quitman	5P2	3117	315221-0850451	Georgetown, 2	355	Pc-Kp (A) Kp-Kr (C) Kc (A)	(?) 35 -53	(?) 88 118	
Randolph	7N6	3046	314905-0845220	Randolph, GGS [1] test well 1	340	Pc-Kp (C)	174	34	
Clay	5L7	—	313628-0850314	Ft. Gaines, 3	232	Pc (A) Pc-Kp (C) Kp (A)	114 -38 -92	152 54 (?)	See table 3 for well construction and water-level data.
Do.	7L6	192	313353-0844805	J. W. West, 1	352	Kp-Kr (C) Kc (A)	-608 -748	140 160	
Early	7K8	—	312342-0844845	McKnight, Lackey, and Tracey, 1	217	Pc (A) Pc-Kp (C)	-255 -525	270 78	
Henry-Alabama	ALA-1	—	312042-0851043	H. D. Granberry, 1	192	Kp-Kr (C) Kc (A)	-883 -908	25 60	Well located in Henry Co., Ala. Alabama Geological Survey No. 631.
Early	5H4	121	311019-0850439	A. C. Chandler, 1	185	Pc (A) Pc-Kp (C) Kp-Kc (A)	(?) -985 -1,015	(?) 30 240	
Do.	5H7	—	310942-0850224	Great Southern Paper Co. (Nursery well)	160	Pc (A)	-518	(?)	

1 Georgia Geologic Survey.

AQUIFER FRAMEWORK AND LITHOLOGY

The lithology of the Providence aquifer shows gradational changes both east and west of the Chattahoochee River valley and southward. Updip near the outcrop area (fig. 3), the aquifer sediments are primarily coarse fluvial sands. Downdip to the south, aquifer sediments are finer-grained and marine in origin. In the Albany-Dougherty County area, the Providence aquifer is a coquina, which grades upward to a siltstone (Hicks and others, 1981, p. 4).

The Providence aquifer is separated from the underlying Cusseta aquifer by the Providence-Ripley confining zone. This zone consists primarily of silts and fine sands of the Perote Member of the Providence Sand and the underlying Ripley Formation. Between the approximate midpoint of the Flint and Ocmulgee Rivers and eastward (fig. 3), the confining zone changes gradationally to a coarse sand and with the Providence and Cusseta aquifers, forms a single aquifer unit (Providence-Cusseta aquifer). Downdip and between the rivers the lower part of the Cusseta Sand changes gradationally to predominantly silt and clay (table 1) and is significantly less permeable than the Providence-Ripley confining zone (fig. 2, table 2). In this area the Providence-Cusseta aquifer consists of sediments of the upper part of the Cusseta Sand, the Ripley Formation, and the Providence Sand (table 1). The area in which the Providence and Cusseta aquifers are differentiated is outlined in figure 3.

The Providence aquifer is confined by overlying clays and fine sands of the Clayton-Providence confining zone (fig. 2; table 1). In updip areas, this confining zone may be absent and the Providence and Clayton aquifers form a single aquifer unit (Clayton-Providence aquifer). A similar condition exists in northern Houston County, where the Providence is overlain by sands of middle Eocene age (LeGrand, 1962, p. 45).

Cartography by Willis G. Hester

HYDROGEOLOGY OF THE PROVIDENCE AQUIFER OF SOUTHWEST GEORGIA.

By
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